March		h.		
27	...	15	...	Jupiter in conjunction with and 4° 40′ north of the Moon.
28	...	3	...	Venus in conjunction with and 0° 36′ south of Mars.
28	...	9	...	Mercury at least distance from the Sun.

GEOGRAPHICAL NOTES

DR. R. VON LENDENFELD, in a letter to Prof. Cayley dated Sydney, January 24, 1885, writes as follows :—I have been sent by the Geological Survey Department of this colony to make a scientific investigation of the central part of the Australian Alps and have returned a few days ago. I found out that the peak, considered as the highest hitherto, which has been measured by several scientists and named Mount Kosciusko, is *not the highest*, and made the first ascent of the highest peak some distance further south. I calculated the height of the latter at 7256 feet (Mount Kosciusko has been measured at 7176, 7175, and, by myself, at 7171 feet). I name this hill after our celebrated geologist, the Rev. W. B. Clarke, Mount Clarke. Further, I discovered indubitable signs of prehistoric glaciers above 5800 feet, and photographed some beautiful *roches moutonnées*. A large valley was filled at the glacial period by a glacier extending 500 feet up its sides. I had excellent weather, and photographed the panorama from the summit of Mount Kosciusko. I had one guide and a geological assistant with me. We camped only three nights, and had glorious weather all the time. The upper limit of trees lies at a height of 5900 feet. Patches of snow are found attached to the leeside of the main range above 6500 feet all the year round—in the European Alps such little *névés* would not lie below 8000 feet—another proof for the lower temperature and greater amount of wet south of the equator, as our Alps lie 46°–48° N., and Mount Kosciusko 37° S. I collected many flowers and geological specimens, and found the whole trip equally enjoyable and interesting. It froze every night, and I cannot tell you how happy and comfortable I felt in the brisk cold air up there, after having been confined to the hothouse climate of Sydney for a year.

THE Vienna correspondent of the *Times* telegraphs that at a private meeting of the committee of the Imperial Geographical Society of Vienna, it has been resolved that Dr. Oscar Lenz, Secretary of the Society, should be sent on a new expedition to explore the watershed between the Nile and the Congo. This expedition has been planned chiefly by Baron Leopold Hofmann, late Imperial Finance Minister, and now President of the Austrian African Association. Dr. Lenz will visit the stations of the International Belgian Society, and one of the objects of his journey will be to find traces of Dr. Junker, Dr. Schnitzler (known in Egypt as Emin Bey), Signor Cassati, and Lupton Bey. Dr. Lenz's journey will be under the special patronage of the Crown Prince of Austria and the King of the Belgians, and the cost will be defrayed partly by the Geographical Society of Vienna, partly by the Government and from private subscriptions. Dr. Lenz proposes to start early in May.

AT the meeting of the Geographical Society of Paris, held on the 6th inst., M. Mascart in the chair, Prince Roland Bonaparte referred to the recent exploration of the Van Braam Morics in New Guinea.—A correspondent of the Society wrote from Ciudad Bolivarin Venezuela that it was reported there that one of the members of the Crévaux mission was still living in captivity among a tribe of Indians, and it is also stated that fragments of a paper were found in a Bolivian forest, on which were written in letters of blood the name of the prisoner and his fate.—M. Teisserenc de Bort described the oasis of Djerid in Tunis. It contains 9,700 inhabitants.—A communication was read with reference to the tribes employed in the recent revolt in Morocco, correcting the names given to them.—M. Schrader read a paper on the masses of snow moved about by the wind amongst mountains. These masses are not carried about by chance—they obey very simple laws, which cause them to be deposited at spots where the wind is diminished in intensity, and give them forms which may easily be analysed when we take into account the quality of the snow, the force and direction of the wind, and the contour of the mountains.—M. Rabot described the results of the mission with which he was charged by the Minister of Public Instruction to explore Northern Finland and Russian Lapland. He explored especially the valleys of the Pasvig and Talom, as well as Lake Enara. The whole region is one immense forest, with lakes and peat-bogs scattered everywhere, and cut up by numerous water-courses. These rivers are the only means of communication, but their navigation is most difficult, on account of cascades and rapids. Lake Enara, which is drained by the Pasvig, is described by M. Rabot as a veritable inland sea, with hundreds of islets covered with magnificent pine trees. The climate is very rigorous. Winter begins in September, and the ice is still in the ground in the beginning of June. The spring is short, but comparatively warm, and it is not rare to see the frost again in August. The country around Lake Enara is level and little broken, and forms a depression between the plateau of Finmark and the masses of hills which stud Russian Lapland.

A WORK which will shortly be published by Prince Roland Bonaparte deals with the populations of Dutch Guiana from an anthropological and sociological point of view. He has studied three groups of the population: (1) the Indians (Caribs); (2) wild Negroes, or Negroes of the woods, being fugitive slaves who have returned to savage life; (3) freed slaves or settled Negroes. The section on the Negroes who have returned to their original state is probably the most interesting of the three. Many of these are descendants of slaves who fled from ill-treatment in the early days of the colony to the woods and inaccessible solitudes of the highlands. In 1712, when Admiral Cassard laid siege to Paramaribo, the planters sent away their slaves into the interior, so that they should not fall into the invader's hands, and they refused to return after the peace. Gradually their number augmented, and these Negroes formed themselves into villages and cultivated land. They grew so powerful that after several bloody and expensive wars, the Colonial Government found it expedient to make a treaty of peace, recognising them as allies, in 1762. At the present moment they number 8000 souls, and are divided into four sections or tribes, according to the locality in which they have settled. They appear to have preserved most of the characteristics of the Negro, but they have adopted many of the habits and modes of life of the Indians, by whom they are surrounded.

THE first number of the *Scottish Geographical Magazine*, the organ of the new Scottish Geographical Society, has been issued. It aims at being much more than the organ of the Society, however. It begins with Mr. Stanley's opening address, and a somewhat perfervid article on Scotland and geographical work. This is followed by a most instructive article by Prof. James Geikie on the physical features of Scotland, accompanied by a map essentially new in design and nomenclature. The geographical notes occupy about fourteen pages, and are unusually full and comprehensive, aiming at a nearly exhaustive chronicle of geographical progress in all departments. This is followed by a *résumé* of geographical literature for 1884, new books and new maps. Besides Prof. Geikie's map there is one of the river basins of Africa, and a portrait of Mr. Stanley. Altogether the *Magazine* is a valuable addition to the literature of its class, creditable to the enterprise of the Society and the knowledge and intelligence of its editors.

ACCIDENTAL EXPLOSIONS PRODUCED BY NON-EXPLOSIVE LIQUIDS[1]

TEN years ago the lecturer discussed in some detail the various causes of the continually recurring casualties which are classed under the head of accidental explosions, and he then had occasion to compare the causes of coal-gas explosions, the occurrence of which is as deplorably frequent now as it was then, with those of accidents connected with the transport, storage, and use of volatile inflammable liquids which are receiving extensive application, chiefly as solvents and as illuminating agents.

Within the last few years he has had occasion to devote special attention to the investigation of instances of this class of accident, and to examine more particularly into the probable causes of frequent casualties connected with the employment of lamps in which the various products included under the general designations of petroleum and paraffin oil are burned. The latter branch of these inquiries, which is still in progress, has been conducted in association with Mr. Boverton Redwood, the talented Secretary and Chemist of the Petroleum Association, and with the valuable aid of Dr. W. Kellner, Assistant-Chemist

[1] Address delivered at the Royal Institution of Great Britain, Friday, March 13, 1885, by Sir Frederick Abel, C.B., D.C.L., F.R.S., M.R.I.

of the War Department. Although it may be hoped that their continuation will lead to further data and conclusions of practical and public importance, it is thought that some account of facts already elicited may interest the members of the Royal Institution, and possess some general value.

Ever since liquids which, more or less rapidly, involve inflammable vapour when freely exposed to air, or partially confined, have been in extensive use, casualties have occurred from time to time through the accidental or thoughtless ignition of the mixtures of vapour and air thus formed, whereby more or less violent and destructive explosions have been produced, often followed by the ignition of the exposed liquid which is the source of the explosive mixture, and by the consequent frequent development of disastrous conflagrations.

Many instances are on record of explosions, sufficiently violent to produce effects destructive or injurious to life and property, resulting from the application of flame to vessels which had contained either the more volatile coal-tar- or petroleum-products, or strong spirituous liquids, and which, though they had been entirely or nearly emptied of their contents, still contained, or retained by absorption within their body, some of the volatile liquid, this having, by evaporation into the air in the emptied receptacle, produced with it a more or less violently explosive mixture. Thus, a loud explosion occurred at the entrance of a lamp-maker's shop in Whitecross Street, which was found to have been caused by a boy throwing a piece of lighted paper into a cask standing under the gateway, which had contained benzoline; two boys were very seriously injured by the blast of flame which was projected from the barrel. A perfectly analogous accident was soon afterwards reported in the papers as having occurred at Sheffield, with serious injury to the author of the catastrophe and another boy; and a very similar case occurred at Exeter during the removal of some empty benzoline barrels, consequent upon a boy applying a lighted match to the hole of one of them. Again, at Spaxton in Somersetshire, a young man applied a light to the hole of a benzoline cask, described as nearly empty, which was standing in the road, when three young men were blown across the road, one of them being so seriously injured about the head that he died.

Explosions with similarly disastrous results have also been publicly recorded as having resulted from the application of a light to rum puncheons and whisky casks, even some time after they have been emptied of their contents, the evaporation of the alcohol absorbed by the wood having sufficed to convert the confined air into a violent explosive mixture.

The readiness or extent to which inflammable vapour is evolved from those products of the distillation of petroleum, or of shale or coal, which are used for illuminating purposes, differs of course considerably with the character of these liquids. Those which are classed as petroleum spirit (known as gasoline, benzine, benzoline, naphtha, japanners' spirit, &c.), and in regard to which there exist very special precautionary enactments, are, it need scarcely be said, of far more dangerous character than those classed as burning oils, which include the paraffin oils obtained from shale and the so-called flashing points of which range from 73° to above 140° Fahrenheit. The rapidity with which the vapours, evolved by the more volatile products on exposure to air, or by their leakage from casks or barrels, diffuse themselves through the air, producing with it more or less violent explosive mixtures, has been a fruitful source of disaster, sometimes of great magnitude. The lecturer had occasion to refer, in his discourse of 1875, to an accident at the Royal College of Chemistry of which he was a witness, in 1847, when the lamented Mr. C. B. Mansfield was engaged in the conversion of a quantity of benzol into nitrobenzol in a capacious glass vessel, which suddenly cracked, allowing the warm liquid hydrocarbon to escape and flow over a large surface. This occurred in an apartment 38 feet long, about 30 feet wide, and 10 feet high; there was a gas jet burning at the extremity of the room opposite to that where the heated liquid was spilled, and within a very brief space of time after the vessel broke, a sheet of flame flashed from the gas jet along the upper part of the room, to the spot where the fluid lay scattered.

The origin of a fire which occurred at some mineral oil stores at Exeter in 1882 affords another striking illustration of the great rapidity with which the vapour of petroleum spirit will diffuse itself through the air. The store which caught fire, and which contained both petroleum oil and spirit, or benzoline, was one of a range of arched caves upon the bank of a canal, being separated from it by a roadway about 50 feet wide. It was a standing rule at the stores that no light should be taken to any one containing benzoline. The casks which contained this liquid were to be removed, and the foreman, desirous of beginning this work early, and forgetful of the rule, went to the store shortly before daylight, carrying a lighted lantern, which he placed upon the ground at a distance of several feet from the door. He then proceeded to open these. As he did so, he noticed a very powerful odour of benzoline, and, almost immediately, he saw a flash of flame proceed from the lantern to the store. He had just turned to escape, when an explosion occurred which blew the doors and the lantern across the canal; the benzoline in the store was at once inflamed, and flowed out into the road and upon the surface of the water, firing a small vessel which lay against the quay, and setting fire to the stores of benzoline contained in two neighbouring caves.

Many exemplifications might be cited of the danger arising from the accidental spilling or escape of petroleum spirit (or even of oils of very low flashing point) in the ordinary course of dealing with these liquids, as in stores where there is but very imperfect ventilation, and in some part of which a flame exists, or is carelessly introduced; or from the escape of spirit or its vapour from stores or receptacles to adjacent spaces where, its existence being unsuspected, the ignition of the resulting explosive mixture of vapour and air may be at any time brought about.

Without referring to accidents which have been due to flagrant carelessness in introducing a flame or striking a light in a store where petroleum vapour is likely to exist in the air, or where some form of spirit has been accidentally spilled, a few instances may be quoted which illustrate the magnitude of casualties liable to arise from the causes just referred to. Some years ago an explosion productive of much damage occurred in a sewer at Greenwich, and was clearly traced to the entrance into the sewer of some petroleum products (from a neighbouring patent gas factory); the vapours from these had diffused themselves through the air in the sewer to a considerable distance, forming with it an explosive mixture which must have been accidentally ignited at one of the sewer openings in the street above. Last spring a similar accident occurred at Newport in Monmouthshire, a quantity of benzoline having escaped into a sewer from a neighbouring store; the ignition of the resulting explosive mixture of vapour and air, with which a considerable length of the sewer became filled, tore up the roadway to some distance, several persons being thrown down. A terrific disaster of the same class was reported from San Francisco in November, 1879. During the driving of a tunnel in the San Jose Santa Cruz Railway, a vein of petroleum became exposed by the excavators, who were, of course, working with naked lights. Three violent explosions occurred in consequence, in rapid succession, resulting in the death of twenty-five Chinamen and in the injury of seventeen others and two white men.

Another accident, which occurred near Coventry nearly five years ago, may be quoted in illustration of the unsuspected manner in which explosive gas-mixtures may exist in localities which, to the superficial observer, may appear to have no connection with a neighbouring locality where volatile liquids are liable to escape confinement.

A dealer in benzoline spirit kept his small store of that liquid (from 20 to 80 gallons) in an apartment of his house, upon the basement, the floor of the room being paved with red bricks. At a distance of about three feet from the store-room there was a well, the depth of which to the surface of the water was twenty feet. The well was closed in almost entirely with planks covered with earth. The water in the well being found foul, the owner had the latter uncovered, with a view to its being cleared out. The workman in charge of the operation, after having been engaged for three hours in pumping out a large quantity of the water, lowered a lighted candle into the well, according to the usual practice, to see whether he could descend with safety, when, while bending over the opening, he perceived a blue flame shooting upwards, and was violently thrown back and badly burnt, a woman who was watching him being similarly injured. The benzoline which had been spilled from time to time in small quantities in filling the cans of customers had readily passed through the porous brick upon which it fell, and, gradually permeating the soil beneath, had, in course of time, drained into the adjacent well. That this must occur under the circumstances described would have been self-evident to any one acquainted with the behaviour of these liquids and with th

attendant circumstances. In localities where large quantities have for some time been stored in the usual casks or barrels, there is no difficulty in "striking oil" by sinking a well in the immediately adjacent ground, in consequence of the large amount of leakage of the spirit or oil which must unavoidably occur. Even in the absence of leakage from the openings of the barrels, or from any accidental imperfection, considerable diffusion of the volatile liquid, and consequent escape by evaporation through the wood itself, must occur in large petroleum-stores, especially if much exposed to the sun, and in the holds of ships where the temperature is generally more or less high. Even the precaution adopted of rinsing the barrels before use with a stiff solution of glue is not effectual in preventing the escape of the spirit from these causes, as the effect of alternations of temperature upon the barrels must tend to reopen any unsound places temporarily closed by the glue. Even at very extensive depôts, where special arrangements were adopted to maintain the stores uniformly at a very moderate average temperature, the loss of petroleum spirit from leakage and evaporation was estimated, ten years ago, to amount to about 18 per cent. of the total stored, while the average loss from the same causes upon petroleum oil was about 9 per cent. By the introduction, from time to time, of improvements of the arrangements, the loss of spirit by leakage and evaporation has been very considerably reduced, amounting to less than 8 per cent. in well-constructed stores, while at some petroleum stores, more especially in Germany, the loss of oil from leakage is now said not to exceed 1 per cent.

As in the case of the loss of coal-laden ships by explosions on the high seas, such loss has probably, in many cases, been due to the development of gas from the cargo, and to its diffusion into the air of parts of the ship more or less distant from the coal, producing an explosive atmosphere which might become ignited by the conveyance or existence of a light or fire, where its presence was not deemed dangerous; so also it is not improbable that the supposed loss by effects of weather of missing petroleum-laden vessels may have occasionally arisen from fire, caused in the first instance by the diffusion of vapour escaping from the cargo through the air in contiguous parts of the ship, and the accidental ignition of the explosive atmosphere thus produced.

The possibility of such disasters has been demonstrated by the repeated occurrence of accidents of this class in ports or their vicinity. A very alarming instance of the kind occurred in 1871 on the Thames off Erith. Two brigantines had nearly completed the discharge of their cargoes of petroleum spirit ("naphtha"), when another vessel, the *Ruth*, from Nova Scotia, containing upwards of 2000 barrels of the same material, together with other inflammable cargo, anchored alongside them. This ship had encountered very severe weather, and it had been necessary to batten down the hatches; the cargo in the hold had consequently become enveloped in the vapour which had escaped from the casks. On the removal of the hatches, an explosive mixture was speedily produced by access of air, and, through some unexplained cause, became ignited shortly after the vessel anchored. A violent explosion followed, and the vessel was almost instantly in flames, the fire being rapidly communicated to the other two ships, which were with difficulty saved, after sustaining considerable injury, while the *Ruth*, in which the fire raged uncontrollably, was after a time towed to a spot where she could burn herself out and sink without damage to the other shipping. Three of the crew were seriously injured by the explosion, and the mate was blown to some distance into the water.

In June, 1873, a vessel (the *Maria Lee*), laden with 300 barrels of petroleum and other inflammable cargo, was destroyed by fire on the Thames near the Purfleet powder magazines, consequent upon the explosion in her of a mixture of petroleum-vapour and air; and a similar accident occurred about the same time in Glasgow harbour. In the case of the *Maria Lee* it was clearly proved that the vapour resulting from leakage and evaporation of the spirit in the hold had diffused itself through the ship during the night, which was very hot, the hatches having been kept closed and covered with tarpaulin, in consequence of the occurrence of a thunderstorm. Upon the captain entering his cabin in the after part of the ship early in the morning (and probably striking a light) a loud explosion took place, and flame was immediately seen issuing from the fore-part of the ship.

A very similar casualty to the foregoing occurred at Liverpool four years afterwards, in a small vessel laden with petroleum-spirit, which proved not to have been at all adapted by internal construction for the safe carriage of such a freight. The cargo of 214 barrels of spirit had been stowed on board, and the hatches were put down and covered with tarpaulin. The cabin and forecastle of the smack were below deck, and were only separated by a thin partition from the hold. The loading had been completed between six and seven o'clock in the evening, and at about eight o'clock the captain went into the cabin and kindled a lamp. A man upon deck, who with another was injured by the explosion and fire, saw the light burning in the forecastle, and almost immediately afterwards the deck was lifted and the man was thrown some distance, while flame issued from the hold. The captain was terribly burned, and died shortly afterwards. In vessels which are constructed for the American petroleum trade, the cabins and forecastles are all upon deck, that part of the vessel which carries the freight, between decks, being as completely as possible separated from the other parts of the ship.

In some instances, ships laden with petroleum oil have become inflamed, in an unexplained manner, without the occurrence of any noticeable explosion, as was the case last year with a large vessel (the *Aurora*) in the port of Calcutta, after she had discharged more than half her cargo of 59,000 cases. The vessel burned for nine hours, the river becoming covered with burning oil as she gradually filled with water; the direction of the wind and the condition of the tide at the time of her sinking fortunately prevented the fire from reaching the shipping higher up the river.

There is no doubt that, while with cargoes of the more volatile petroleum products, classed as spirit, the greatest precautions are necessary to guard against the possible ignition of more or less explosive mixtures of vapour and air which will be formed in the stowage spaces of ships, and which may extend to other parts of the vessels unless very efficient ventilation be maintained, ships laden with the oils produced for use in ordinary petroleum or paraffin lamps, and which, yielding vapours at temperatures above the standard fixed as a guarantee of safety, incur comparatively very little risk of accident, provided simple precautions be observed. If, moreover, by some act of carelessness, or some accident not guarded against by the prescribed precautions, a part of such cargo does become ignited, the prompt and, as far as practicable, complete exclusion of air from the seat of fire, by the secure battening down of the hatches, will most probably save the ship from destruction. There are numerous records of vessels having discharged cargoes of petroleum oil, many barrels of which have been found greatly charred on the outside, occasionally even to such an extent that the receptacle has scarcely sufficient strength remaining to retain its contents. A remarkable illustration of the controllable nature of a fire in a petroleum-laden ship was furnished by the ship *Joseph Fish*, laden with refined petroleum, lubricating oil, and turpentine, which, a fortnight after leaving New York (in September, 1879), was struck by lightning during a heavy squall, the hatches being closed at the time. Smoke at once issued from below, and the force-pumps were set to work directly to keep the fire down. The hatches were removed for examination as the fire appeared to gain ground, but were immediately replaced, and, after further pumping, as the fire appeared to increase, and an explosion was feared, the crew took to their boats, remaining near the ship. Eight hours afterwards they were picked up by a passing ship, which remained near the *Joseph Fish* until daylight. Her captain then returned on board, and as he found that the fire appeared to be out, the crew returned and the ship resumed her voyage, reaching the port of London without further incident, except that, during the use of the pumps for removing the water, considerable quantities of petroleum and turpentine were pumped up with it from the hold. When the cargo was discharged, a large number of the barrels bore evidence of the great heat to which they had been exposed; several casks had gone to pieces, and the staves of others were charred quite half-way through, although they still retained their contents.

The lecturer had occasion, ten years ago, to dwell upon the recklessness with which fearful risks were incurred, in some cases no doubt ignorantly, but in others scarcely without a knowledge, on the part of those who were responsible, of the nature of the materials dealt with, by transporting volatile and highly inflammable liquids together with explosive substances in barges or other craft, and in doing so, moreover, without the adoption of even the most obvious precautions for guarding against access

of fire to the contents of those vessels. The instance of the explosion, in 1864, of the *Lottie Sleigh* at Liverpool, laden with 11½ tons of gunpowder, in consequence of the accidental spilling and ignition of some paraffin oil in the cabin of the ship, illustrated the danger incurred in permitting these materials to be together on board a vessel, and should have furnished some warning by the publicity it received; but the explosion, ten years later, on the Regent's Park canal, of the barge *Tilbury*, revealed the continued prevalence of the same reckless disregard of all dictates of common prudence in dealing with the joint transport of explosives and volatile inflammable liquids.

The efficient laws and Government inspection to which all traffic in explosives has since then been subject, have rendered the recurrence of that identical kind of catastrophe almost out of the question, but an illustration has not been wanting quite recently of the fact that, but for the respect commanded by the rigour of the law, barges passing through towns would probably still carry freights composed of petroleum spirit and powder or other explosives, being at the same time provided with a stove, lamp, and matches for the convenient production of explosions. In August, 1883, an explosion occurred on the canal at Bath, in a barge which sank immediately, the master being slightly injured; the freight of the vessel consisted of petroleum, benzoline, and lucifer-matches.

The last four years have furnished several very remarkable illustrations of great injuries inflicted on ships by explosions, the origin of which was traced to the existence on board of only small quantities of some preparation containing petroleum spirit, or benzoline, with the nature of which the men who had charge of them were not properly acquainted. These materials had, consequently, been so dealt with as to become the means of filling more or less confined spaces in the ships with an explosive atmosphere which, when some portion of it reached a flame, was fired throughout, with violently destructive effects.

The first authenticated case of an accident due to this cause occurred in June, 1880, on board the Pacific Steam Navigation Company's steamer *Coquimbo*, shortly after her arrival in the morning at Valparaiso from Coquimbo. A violent explosion took place, without any warning or apparent cause, in the fore-peak of the vessel, blowing out several plates of the bow and doing other structural damage, besides killing the ship's carpenter; the explosion could only be accounted for by the circumstance that a small quantity of a benzoline preparation used for painting purposes (probably as "driers") was stored in the fore-peak and that a mixture of the vapour from this with the air had become ignited. The sufferer was the only person who could have thrown light upon the precise cause of the accident, but there was no other material whatever in that part of the ship to which the explosion could have been in any way ascribed.

In May, 1881, an explosion of a trifling character occurred on board H.M.S. *Cockatrice* in Sheerness Dockyard, in consequence of a man going into the store-room with a naked light and holding it close to a small can which was uncorked at the time, and which contained a preparation recently introduced into the naval service as a "driers" for use with paint, under the name of *Xerotine Siccative*. This preparation, which was of foreign origin, appears to have been adopted for use in the naval service and to have been issued to H.M.'s ships generally without any knowledge of its composition and without attention being directed to the fact that it consisted very largely of the most volatile petroleum spirit, which would evaporate freely if the liquid were exposed to air at ordinary temperatures, and the escape of which from a can, jar, or cask, placed in some confined and non-ventilated space, must speedily diffuse itself through the air, and render the latter more or less violently explosive.

When attention was directed to the highly inflammable character of this xerotine siccative by the slight accident referred to, official instructions were issued by the Admiralty, in June, 1881, to ships and dockyards that the preparation should be stored and treated with the same precautions as turpentine and other highly inflammable liquids or preparations.

The following November, however, telegraphic news was received of a very serious explosion on board H.M.S. *Triumph*, then stationed at Coquimbo, due to the xerotine siccative. The explosion took place early in the evening of November 23, and originated in one of the paint-rooms of the ship; the painter, and a marine who was assisting him, were in the upper paint-room at the time; the former received severe internal injuries and afterwards died, the latter was killed at once. One man standing at the open door of the sick bay furthest from the explosion was instantaneously killed, others in close proximity receiving only superficial injuries. Altogether there were two killed, two dangerously wounded—of whom one died—and six injured by the explosion.

The results of the official inquiry held at Callao led to the conclusion that the explosion was caused by the ignition of an explosive gas-mixture produced by xerotine siccative which had leaked from a tin kept in a compartment under the paint-room and quite at the bottom of the ship, usually termed the "glory hole;" that locality having been considered by the captain of the ship as the safest place in which to keep this material, to the dangerous nature of which his attention had been recently called by the receipt of the Admiralty Circular. It transpired that the painter had sent his assistant down to this compartment from the paint-room to fetch some paint. The man, who had a hand-lantern with him, while opening the hatch, which had not been opened for three days, made a remark that there was a horrible smell; the chief painter told him to return, as he thought the smell was due to foul air, and immediately afterwards the explosion occurred.

The tin can which had contained six gallons of the liquid was found, after the accident, to have received injury as though some heavy body had fallen, or been placed, upon it; this appeared to have been done before the explosion, and there is no doubt that the liquid had leaked out of the can, and had evaporated into the air in the compartment beneath the paint-room, and probably also to some extent in the adjoining spaces. The damage done was very considerable. An iron ladder leading from one paint-room to the other was so twisted up as to have lost all semblance of originality, the wooden bulkhead separating the upper paint-room and sick bay was completely blown away, the framing of the ship's side in the sick bay was blown inwards and broken, the furniture in the latter was completely shattered, and the bedding and clothes of the men near the explosion were much burned. The inquiries which followed upon this deplorable accident showed that, while due precautions were taken to store the supplies of mineral oil used for burning purposes, of turpentine and of spirit, which were sent to different naval stations for supply to the fleet, in special parts of the ship or on deck, this highly inflammable liquid, which was far more dangerous than other stores of this class, had been sent in freight-ships as common cargo, being stored in the hold without any precautions. A stone jar which was advised as containing a supply had arrived at its destination in the Pacific quite empty, the contents having leaked out and evaporated on the passage out, so that the vessel carrying it had been unsuspectedly exposed to very great danger.

(*To be continued.*)

PROGRAMME OF WORK TO BE PURSUED AT THE U.S. NAVAL OBSERVATORY AT WASHINGTON, D.C., DURING THE YEAR BEGINNING JANUARY 1, 1885[1]

The Great Equatorial

1. OBSERVATIONS of a selected list of double stars will be continued. These stars are such as have rapid orbital motions, or which present some other interesting peculiarity.

2. Conjunctions of the inner satellites of Saturn during the opposition of the planet will be observed. There will also be made a complete micrometrical measurement of the dimensions of the ring.

3. There will be made three drawings of Saturn—one before opposition; one at or near opposition; and one after opposition.

4. The observations which have been begun for stellar parallax, and for the temperature coefficient of the screw of the micrometer, will be finished.

The Transit Circle

1. Observations of the sun will be made whenever the necessary ephemeris stars can be observed, and the required instrumental corrections determined.

2. The moon will be observed through the whole lunation.

3. The major planets will be observed from fifteen to twenty times, near opposition.

[1] Transmitted by Commodore S. R. Franklin, U.S.N. Superintendent.